Description

Magnetic linear drive

The invention relates to a magnetic linear drive having a base and having a first movable part, which can be moved along an axis, wherein a first magnetic force effect for movement of the first movable part can be produced between the base and the first movable part, and a second magnetic force effect for movement of the second movable part can be produced between the first movable part and a second movable part which can be moved along the axis.

One such magnetic linear drive is known, for example, from the Swiss Patent Specification CH 184 977. The known linear drive has a plurality of windings, into which an armature is drawn when current flows through the windings. The known armature is formed in a number of parts, with each part of the armature being mounted in a guide sleeve which is in each case attached to the magnet housing and to the pole shoes. The individual parts of the armature can be moved relative to one another, but only by a certain amount, which is governed by an air gap. A movement of the individual parts of the armature is in each case provided, in the form of a chain, in a fixed sequence in order to omit a movement to an element that is to be driven.

The movement which can be tapped off from the known drive can take place only on the basis of a single pattern, which is fixed and is predetermined by the design. Flexible use of the drive is thus possible only to a restricted extent. Furthermore, the armature must be assembled from a very large number

of individual parts in order to achieve a large linear movement, so as to produce a correspondingly large number of air gaps between the individual parts and to produce a large linear movement overall.

A further magnetic linear drive is known, for example, from European Patent Specification EP 0 830 699 B1. The arrangement has a coil through which a current can flow. A drive rod is moved by the magnetic field originating from the coil, using the force effects on permeable boundary surfaces. The drive rod enters the interior of the coil in the process.

The force effect on the movable part changes depending on the depth to which the drive rod enters the coil. The linear movement of a linear drive such as this is restricted.

The present invention is based on the object of designing a magnetic linear drive of the type mentioned initially such that the movement sequence can be controlled easily, with the movable part having a long linear movement. A further object is to specify a suitable method for operation of a magnetic linear drive such as this.

According to the invention, the object is achieved for a magnetic linear drive of the type mentioned initially by the second movable part being mounted such that it can move on the first movable part.

The provision of two movements of two parts which can be moved independently of one another makes it easier to control a movement sequence. A large number of movement profiles can be created by acceleration or deliberate braking of in each case one of the movable parts or corresponding superimposition of the movements of the two movable parts. Furthermore, it is also possible to drive only one of the movable parts, so that the magnetic linear drive can produce only a limited linear

movement. Furthermore, the splitting into linear movement elements of a first movable part and of a second movable part makes it possible to produce a better force profile throughout the entire movement. The magnetic forces which can be produced between the first movable part and the second movable part, as well as between the base and the first movable part, can each be produced independently of one another. The total force requirement for a movement can thus be distributed between a plurality of elements. The magnitude and time profile of any force effect can thus be optimized per se, without directly influencing the other force effect at the same time. Overall, the two magnetic force effects complement one another to form a resultant force effect. A magnetic linear drive such as this can be used as a drive for a medium-voltage or high-voltage switch, in particular for a circuit breaker.

Magnetic force effects can be produced, for example, by a combination of coils through which a current flows, permanent magnets and high-permeability material. Magnetic force effects can easily be matched to the technical requirements. Robust mechanical structures, which are subject to only a small amount of mechanical wear, can in this case be chosen in order to transmit the forces.

Mounting the second movable part on the first movable part makes it possible to

couple the movements of the movable parts to one another in a simple manner. The second movable part can be repelled from the first movable part and can thus be moved in a simple manner either at the same time as the first part or at a time after or before any movement of the first part. In comparison to known designs, this makes it possible to produce a sufficiently large force effect over the entire movement distance of the entire movement, with an increased linear movement.

Furthermore, it is advantageously possible to provide for a first and a second permanent magnet to be aligned with respect to one another in such a way that, in a limit position of the magnetic linear drive, the magnetic fluxes of the first permanent magnet and of the second permanent magnet are closed along a common path within a high-permeability multiple part core body.

The use of permanent magnets to secure the positions means that there is no need for mechanical latches for the magnetic linear